

heavy water production utilizing the ammonia-hydrogen exchange process.

- f. Infrared absorption analyzers capable of "on-line" hydrogen/deuterium ratio analysis where deuterium concentrations are equal to or greater than 90%.
- g. Catalytic burners for the conversion of enriched deuterium gas into heavy water especially designed or prepared for heavy water production utilizing the ammonia-hydrogen exchange process.

**4106. Plants and systems, and specially designed or prepared equipment therefor, for the processing of special and other fissionable materials and source materials, including**

- a. plants and systems for the production of uranium hexafluoride;
- b. plants and systems for the conversion of plutonium nitrate to plutonium oxide; and
- c. plants and systems for the production of plutonium metal.

**4202. Power-generating or propulsion equipment that is specially designed or prepared for use with military, space, marine or mobile nuclear reactors.**

**4203. Electrolytic cells that are for the production of fluorine and that have a production capacity of greater than 0.25 kg of fluorine per hour.**

**4204. Equipment that is specially designed or prepared for the separation of isotopes of lithium.**

**4205. Plants for the production, recovery, extraction, concentration or handling of tritium and its compounds and mixtures, and specially designed or prepared equipment therefor.**

**4206. Frequency changers, converters or inverters that are specially designed or prepared to supply motor stators for gas centrifuge enrichment, and subassemblies and specially designed components therefor, and that have**

- a. a multiphase output of 600 to 2 000 Hz;
- b. a frequency control of better than 0.1 per cent;
- c. a harmonic distortion of less than 2 per cent; and
- d. an efficiency of greater than 80 per cent.

**4220. Mass spectrometers that are specially designed or modified for measuring from on-line samples the isotopic composition of feed, product or tails from uranium hexafluoride gas streams and that have**

- a. a unit resolution for mass greater than 230;
- b. an ion-source utilizing electron bombardment that is
  1. nickel-plated,
  2. constructed of nichrome or monel, or
  3. lined with nichrome or monel; and
- c. a collector system that is suitable for isotopic analysis.

**4221. Process control instrumentation that is specially designed or modified for monitoring or controlling the processing of irradiated source materials and special and other fissionable materials.**

**PART II - NUCLEAR-RELATED DUAL-USE LIST**

**4500 LIST OF NUCLEAR-RELATED DUAL-USE EQUIPMENT AND MATERIALS AND RELATED TECHNOLOGY**

**4501. INDUSTRIAL EQUIPMENT**

4501. 1. Spin-forming and flow-forming machines:
  - a. which can be equipped with "numerical control" units or a computer control; and

b. with two or more axes that can be coordinated simultaneously for "contouring control,"

and precision rotor-forming mandrels designed to form cylindrical rotors of inside diameter between 75 mm (3 in.) and 400 mm (16 in.) and specially designed software therefor.

**NOTE:**

Only spin-forming machines combining the function of spin-forming and flow-forming are included in Item 4501.1.

4501. 2. "Numerical control" units, specially designed "motion control boards" for "numerical control" applications on machine tools, "numerically controlled" machine tools, specially designed "software," and technology as follows.

4501. 2. a. "Numerical control" units for machine tools, as follows:

1. Having more than four interpolating axes that can be coordinated simultaneously for "contouring control" or
2. Having two, three, or four interpolating axes that can be coordinated simultaneously for "contouring control" and one or more of the following conditions are fulfilled:

- a. Capable of "real-time processing" of data to modify the tool path during the machining operation by automatic calculation and modification of "part program" data for machining in two or more axes by means of measuring cycles and access to source data;
- b. Capable of receiving directly (on-line) and processing computer-aided design (CAD) data for internal preparation of machine instructions; or
- c. Capable, without modification, according to the manufacturer's technical specifications, of accepting additional boards that would permit increasing the number of interpolating axes that can be coordinated simultaneously for "contouring control," above the control levels, even if they do not contain these additional boards.

4501. 2. b. "Motion control boards" specially designed for machine tools having one or more of the following characteristics:

1. Providing interpolation in more than four axes;
2. Capable of "real time processing" described in 4501.2.a.2.a; or
3. Capable of receiving and processing CAD data as described in 4501.2.a.2.b. above.

**NOTE 1:**

Subitems (a) and (b) do not include "numerical control" units and "motion control boards" if

- a. Modified for and incorporated in uncontrolled machines; or
- b. Specially designed for uncontrolled machines.

**NOTE 2:**

"Software" (including documentation) for "numerical control" units that may be exported must be:

- a. In machine executable form only; and
  - b. Limited to the minimum necessary for the use (i.e., installation, operation, and maintenance) of these units.
- c. Machine tools, as follows, for removing or cutting metals, ceramics, or composites, which, according to the manufacturer's technical specifications, can be equipped with electronic devices for simultaneous "contouring control" in two or more axes:

**TECHNICAL NOTE:**

1. The c-axis on jig grinders used to maintain grinding wheels normal to the work surfaces is not considered a contouring rotary axis.
2. Not counted in the total number of contouring axes are secondary parallel contouring axes, e.g., a secondary rotary axis, the centre line of which is parallel to the primary rotary axis.
3. Axis nomenclature shall be in accordance with International Standard ISO 841, "Numerical Control Machine Axis and Motion Nomenclature."
4. Rotary axes do not necessarily have to rotate over 360°. A rotary axis can be driven by a linear device, e.g., a screw or a rack-and-pinion.

4501. 2. c. 1. Machine tools for turning, grinding, milling, or any combination thereof that: